DOCUMENT RESUME

ED 031 092 EM 007 290

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Costs of Educational Media Systems. A Series II Occasional Paper from ERIC at Stanford.

Stanford Univ., Calif. ERIC Clearinghouse on Educational Media and Technology.
Spons Agency-Office of Education (DHEW), Washington, D.C.
Pub Date Jun 69
Note-41p.; Abridgement of Vols. I & II of "Cost Study of Educational Media Systems and Their Equipment Components"
EDRS Price MF-$0.25 HC-$2.15
Descriptors-Airborne Television, Capital Outlay (for Fixed Assets), Closed Circuit Television, *Cost Effectiveness, Costs, Dial Access Information Systems, Educational Finance, Educational Radio, *Estimated Costs, Expenditure Per Student, Films, Fixed Service Television, Initial Expenses, *Instructional Television, Language Laboratories, Operating Expenses, Program Budgeting, Program Effectiveness, Program Evaluation, *Resource Allocations, Video Tape Recordings

Investigating the costs of instructional media systems necessitated that those systems be identified and analyzed, and that a methodology be formulated for estimating their costs, with reference to their area of operation: local, city, metropolitan, state, or regional school areas. Costs are broken down into cost per student per year, according to production costs, distribution costs, reception costs, and total cost for each instructional medium examined. These media are: airborne television, Instructional Television Fixed Service, satellite television, UHF (ultra high frequency) television, closed-circuit television, videtape recordings, film, radio, language laboratories, and dial access systems. A distinction is made between capital and operating costs, and a further breakdown of costs lists them according to whether the media are high quality, minimal, or derive from a national programing source. A significant pattern emerges: cost per student dips sharply as the area widens and the number of students increases for all media (videotape recording costs are in any case prohibitive). This pattern is a key factor in the recommendations for cost savings which postulate widespread use of media, improvement of production quality by the use of improved technology, reorganization of educational systems in terms of the new technology. (GO)

ED031092

A PAPER FROM

ERIC at Stanford

ERIC Clearinghouse on Educational Media and Technology
at the Institute for Communication Research, Stanford University, Stanford, Calif. 94305

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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COSTS OF EDUCATIONAL MEDIA SYSTEMS

By Michael G. Sovereign

With a Section on Legal Restrictions
on the Use of Film by Joseph E. Lynch

An Abridgment of the First Two
Volumes of *Cost Study of Educational Media Systems and Their Equipment Components*

Which was submitted to the Bureau of Research,
U.S. Office of Education, under
Contract OEC-1070079006-5139
by the General Learning Corporation.

This Abridgement Was Issued
as a Series II paper by ERIC at Stanford
in June 1969

EM007290

INTRODUCTION

In view of the national goal to provide every citizen the opportunity for quality education to the level of his desire and ability, the educator is confronted with the task of providing each student with the best education possible within the bounds of available funds, personnel, and facilities. Educational media systems may be a valuable source of help in the accomplishment of this task. Because of the lack of sufficient data, the selection of the best medium for presentation of a particular instructional unit usually is based on a subjective evaluation of effectiveness and a superficial estimate of cost.

The purpose of this study was to investigate the cost of instructional media systems. The first objective was to provide the educator with a set of guidelines for realistically estimating the total cost of such systems. To gain this objective it was necessary first to identify and investigate a set of commonly used or proposed media systems and to develop a methodology for determining total system costs.

The data collected and analyzed during the study achieved the second objective of providing a data base for use by researchers in further studies relating to the selection, implementation, and operation of instructional media systems. A final objective of the study was to present recommendations which can result in cost savings when media systems are used. The recommendations are in the areas of media utilization, application of new technology, and educational system organization.

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SELECTION OF A MEDIA SYSTEM–AN OVERVIEW

Estimating the costs of purchasing, installing, implementing, and operating a media system is not an isolated activity. Rather, it is part of the broader overall process of media system selection.

Cost estimation, the subject of this study, must be preceded–and followed–by certain other necessary activities to insure optimum results from the use of a media system. These activities, while outside the scope of this study, are examined briefly here to show their relation to cost estimation.

The major steps in media system selection appear graphically in Fig 1. Although the component activities are presented and discussed sequentially, it should be emphasized that the steps in media selection are interactive. The results of an activity or activities in one step may not only provide data for a subsequent activity, but may also modify activities that have gone before.

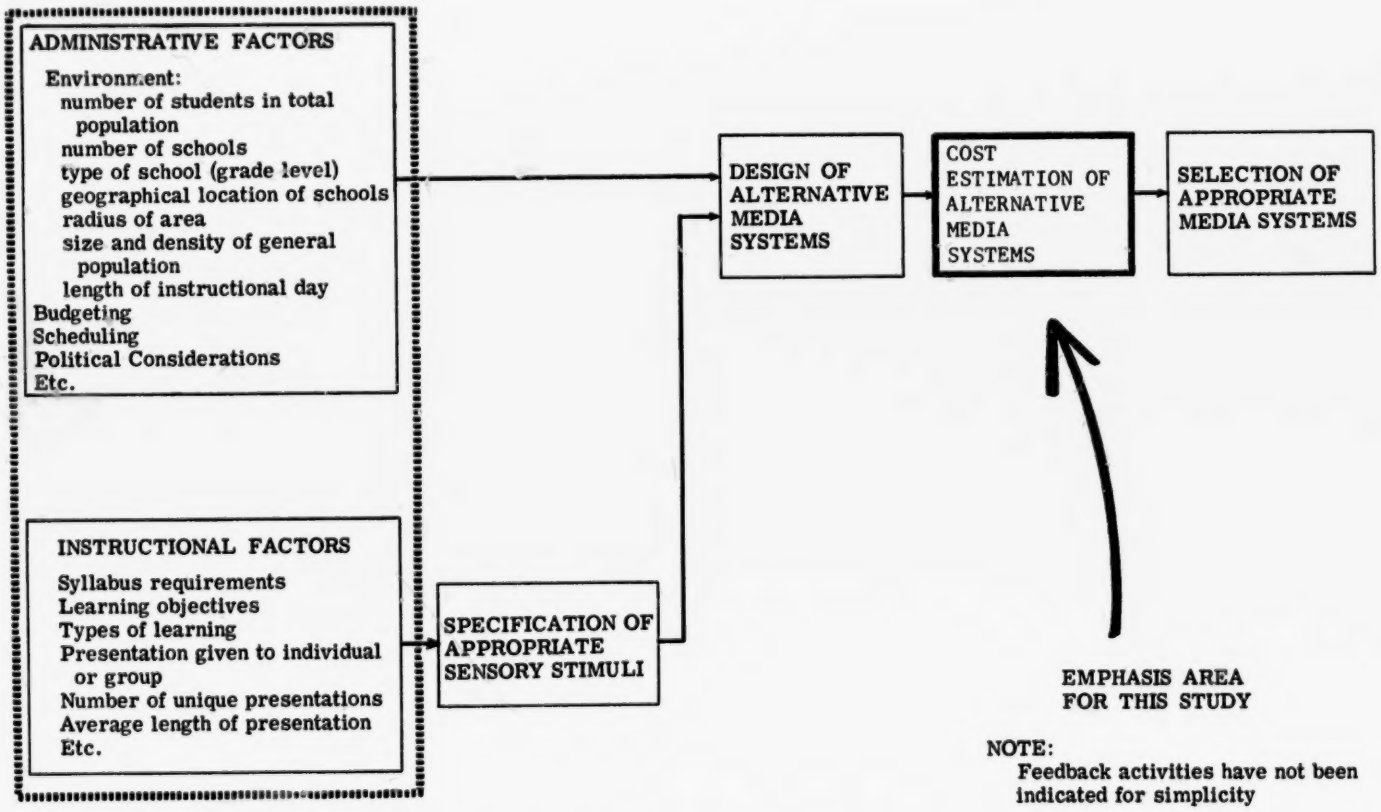

Figure 1. Selection of a Media System–An Overview

The selection process begins with an examination of the educational setting in which the chosen media system is to function. Most educators agree that this setting consists mainly of an administrative component and an instructional component. Each component contains limiting factors which shape the specific data used in later stages

of the selection process, namely specification of appropriate sensory stimuli, design of alternative media systems, cost estimation of the alternative systems and, ultimately, selection of the appropriate system.

Final selection of a media system is followed by the customary procedures of contract specification, review of bids, and award of a contract for equipment and installation. Two other "post selection" activities are essential at this point–implementation (training and operation) and evaluation. Logically, planning for these activities should be completed well before this time. Some of the groundwork should already have been laid at earlier stages of the selection process. Staff acceptance of new media is more likely if teachers have participated in the selection process and have received instruction in how the new media are to be used. Operating procedures which allow for a period of adjustment must be carefully planned and introduced.

Fig. 2 illustrates the sequence of general steps taken to determine the cost of a media system. Blocks 1 and 2 produce the media system characteristics which determine the system's configuration. Blocks 3, 4, and 5 develop the costs in each of the three divisions into which the system has been separated. Block 6 sums up all costs prior to the selection decision that is made in Block 7. Actually, decisions are made throughout the entire process and some systems may be rejected or modified well before Block 7 is reached.

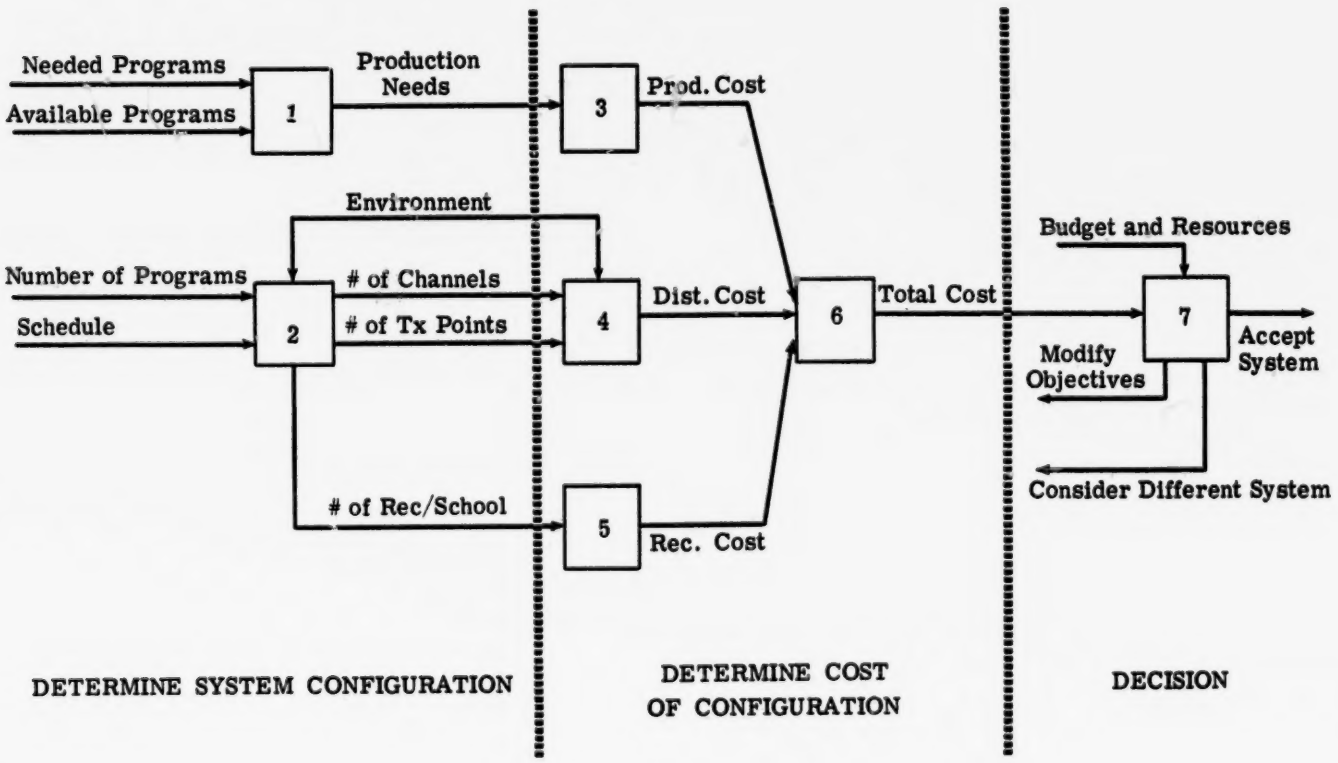

Figure 2. Cost Determinations

METHODOLOGY

The method of the study involves the specification of a task and an environment. The task describes "what the system is doing" and the environment describes "over what area and for how many people it is doing it." A valid comparison of media systems can be made only when a single *real* environment and the *actual* educational task are specified in detail for each case under study. To attempt this type of approach would mean the illustration of hundreds of cases consisting of different systems and their variations applied to many educational tasks over many different environments. This monumental effort would still involve some generalizations and assumptions and would only produce a larger group of system costs which might result in more confusion than clarification.

Therefore, we have chosen a general expression for the task and a small number of generalized environments to construct a framework for media costs. Hopefully, this method may reduce the errors in system comparisons. It will not eliminate them. Where a media system does not fit a portion of the model at all, it will be so indicated. Where a media system does not fit a portion of the model as well as another system, it will be costed and explanatory notes appended (in the full original report) to describe the problem.

Environments Defined

Each media system is costed with respect to a number of environments. The environments are to a great extent hypothetical. However, they are models which were created after examining actual data. In particular, city and metropolitan area descriptions closely resemble the city of Washington, D. C. and its environs. The geographical areas and population densities of the other environments are similar to those found in section of the United States.

Local District Model: The smallest environment is the school district which may vary in size from a few hundred to over a million students. The size chosen for this study was 15,000 elementary and secondary students in an area of approximately 80 square miles. Although the majority of school districts in the United States are much smaller, those with 3,000 or 4,000 students will not have the distribution problems which become extremely important in larger systems. Also, some of the media systems are too expensive (even in their smallest configuration) to be supported by a small district. However, if these smaller administrative units join together in a cooperative effort of about 15,000 students, the costs can be apportioned on a per pupil rate for each unit.

The school district used as the model consists of 14 elementary schools and

four secondary schools. The elementary schools are a combination of K-6 and K-8 configurations, and the secondary schools include junior, senior, and possibly a vocational high school. For the purpose of this study, an elementary school will have an *average* of about 600 students; a secondary school will have an average of about 1,400 students. (The student population in each environment [local, city, state, etc.] has been rounded off to form convenient numbers; as a result the number of students per school when multiplied by the number of schools will not produce the exact student population indicated.) The school district is irregular in shape, but all the schools are within a circle whose radius is six miles.

City Model: The city covers an area of 70 square miles and has a total population of about 800,000 with approximately 11,500 people per square mile. The shape of the city is roughly rectangular and the entire area can be encompassed by a six mile radius circle. There are 150,000 students in 136 elementary and 46 secondary schools. The city can consist of a single school district or a number of school districts which cooperate to gain efficiency and economy through the use of a common media system. The city is not the largest nor most densely populated in the United States. By way of comparison, New York City has approximately nine times the population, four times the area, and more than twice the population density of the city used in this study.

Metropolitan Area Model: The population of the metropolitan area is approximately two million. Its perimeter has an irregular shape and surrounds an area of approximately 1500 square miles. Because of its irregular shape, a circle with a 30 miles radius (2800 sq. mi.) is necessary to completely cover this area.

The metropolitan area, which contains a number of school districts, has 546 elementary and 183 secondary schools with a total of 600,000 students (K-12). It is assumed that these districts would cooperate with one another for some large media projects to achieve economy of operation.

State Model: The state has a population of about 4.5 million people. It does not contain a metropolitan area as large nor as populous as described above, though about 60 percent of the population is urban. It has an area of about 40,000 square miles and a population density of about 110 per square mile. Approximately one million students (K-12) are distributed among 920 elementary and 310 secondary schools.

Regional Model: The region is approximately a 10 to 1 extrapolation of the state, but a smaller population density is used to bring this figure closer to the national average. The region has an area of 550,000 square miles and a population of about 42 million. There are 10 million students in 9200 elementary and 3100 secondary schools. The region contains a few widely distributed metropolitan areas but no continuous corridor such as is found between Boston and Washington. (The corridor is considered separately in the full original report.)

Educational Task Defined

The task assumed in this report is: *To provide each student with material via some medium during an average of 10% of his actual instructional time.* In reality, no subject is taught entirely by the use of a media system. Some subjects may not use the media system at all. More than 10% of some subject may be presented by a media system. This task is general in nature so that it may be applied to any system. When a single system is considered for solving an actual problem, the task can be specified in terms of particular subject material and relative effectiveness of the media for the material.

A difficulty with respect to this study is not that the task is general in nature, but that is is not defined in *units* that have a relationship to system design. To bridge this gap, the following exercise is offered to illustrate the method used for this study to convert the general 10% task into an annual requirement for hours of unique program material for each of the defined environments. In a real situation, this exercise is unnecessary. The programs, lesson units, and other related factors would be determined from the educational objectives of the real situation.

Program Requirements for a Local Environment

What follows is a description of the method used in this study to estimate the approximate number of unique programs which would have to be produced or acquired to perform a generalized educational assignment over a period of one year. The method is applied to grades 1 through 12 in two separate groups: grades 1-8 and grades 9-12. Only the calculation for grades 1-8 is shown in this abridgment.

For this illustration, it is assumed that general program material (enrichment, background material, general science, etc.) is acceptable for use over a four-grade span (average), e.g., 1-4, 3-6, 9-12. It is also assumed that specific subject-oriented material is acceptable for use in a single grade and only by a portion of the students within that grade; for example, Algebra I may only be applicable to algebra students in grade 8.

It is assumed that the students in grades 1-8 are all engaged in a single course of study, though this is not without exception. In some cases, course specialization may occur in grades 7 and 8; occasionally, elementary schools, especially private schools, may offer different courses. It is assumed that there are 900 hours in a school year.

180 days/year x 5 hours/day = 900 hours/year

It is assumed that 70% of the student's total time in school is available to receive media presentations. (This excludes lunch, study periods, etc.)

900 hours x 0.7 = 630 hours available for media presentation.

It is assumed that media will be used an average of 10% of this time.

630 hours x 0.1 = 63 hours average media usage/student/year

It is assumed that 50% of the material presented applies to only a single grade.

63 hours/grade x 8 grades x 0.5 = 252 hours of material for single grade use

It is assumed that 50% of the material is applied to an average of four grades (some material may apply to eight grades).

63 hours/grade x $\frac{8}{4}$ x 0.5 = 63 hours of material for multigrade use

252 hours single grade materials

63 hours multigrade materials

315 hours of unique material for grades 1-8

Total unique programming

grades 1- 8 = 315 hours

9-12 = 655 hours (Calculation of this is shown in the full report.)

= 970 hours of 1000 hours

It is assumed that each program is 20 minutes long.

1,000 hours x 3 program/hour = 3,000 unique programs to supply 10% average media coverage in a local district

Program Requirements for City Environment and Above

If 1,000 unique program hours are sufficient to accomplish the task assigned to a single school district, will the same number of hours be sufficient for all the school districts in a state?

The concept of unique programming hours used in this study does not directly take into account the actual subject material involved. The method may be adequate to determine the average number of unique programming hours needed in a school or school district. However, an increase in *overall* program hours may be necessary when the task is applied to a larger environment such as a state or region. The 1,000 hours may be adequate to supply each student (on an average) in a school or district with 10% media usage or availability. Due to overall curriculum differences, such as a larger number of subject offerings and differences in teaching methods, the 1,000 hours of unique programming may be insufficient to provide 10% media coverage when applied to a large number of schools or school districts.

Taking this factor into account, the following number of hours of unique programming will be assigned to each area.

Local	1,000 hours
City	1,200 hours
Metropolitan area	1,300 hours
State	1,500 hours
Region	1,600 hours

Cost Structure

The stated task, to provide each student with material via some medium during an average of 10% of his total instructional time, offers a common source of data for the design of each media system. The definition of environments provides a method of examining systems as they are affected by an alteration in the size of the environment.

Classification by Function–Analysis for cost estimation can be further aided by classification of the elements of each media system as they relate to production, distribution, and reception.

Production: Production costs are those incurred in the inception, creation, development, and preparation of the instructional content. The acquisition of media programs and its related costs, such as selection and order handling, are also classified as production costs. For a media system, these costs must include the cost of curriculum design, the use and development of research and evaluation teams, media specialists, facilities, and all the myriad of inputs necessary to produce a successful learning experience for the student. Specific examples are script writing and recording of programs for radio and television.

Distribution: Distribution costs are those incurred in changing or copying the material from its original form, if necessary, and sending it to a point at which it will be reconverted to a usable form for the student. Usually, the transmitted material is not in a form which is immediately useful to the student. Examples are duplicating original tape and broadcasting for television, duplicating and mailing film from a processing center to a school, or duplicating and playing tape and transmitting to headphones in language laboratories.

Reception: Reception costs are those incurred in changing the form and presenting the distributed material so that it is useful to the student. Examples are antennas, TV sets, film projectors, screens, headphones, and carrels.

Classification as Capital or Operating Costs–Production, distribution, and reception costs can be classified as either capital (initial) costs or operating (annual) costs. Costs classified as capital costs include all purchases of goods and services that have a useful value of longer than a year or that are not incurred every year. The

following items are considered as capital costs.

1. Initial planning. A breakdown of the planning effort and some estimates of man hours, travel costs, fees, etc., must be made for each system. The planning effort includes these activities.

   Survey of educational needs
   Definition of the problem
   Examination of possible solutions
   Design of systems
   Technical assistance and consultation
   Determining cost of alternative proposals

2. Initial training. In order to start a media system with a reasonable level of efficiency, a formal training program should be in operation prior to and during the installation of the system. Traditionally, problems of attitude have developed with the ultimate users when they were not properly informed, motivated, and trained. Training can be subdivided into three areas:

   Training of teachers, producers, and others who will actually produce the programs for the media
   Training of the technical operating and maintenance staff
   Training of classroom teachers to properly utilize the media

   The amount of training depends on the size of the system, intensity of usage, and the quality of performance which will be acceptable. Historically, it has depended upon the time and money that are available for this purpose.

3. Facilities. When an entire room, group of rooms, or separate building (such as a TV studio or film library) is required for a media function, it will be costed as new construction on a square foot basis and provision for future expansion is assumed.

   When a very small area of an existing facility (such as space taken by a TV set in classroom) is used, these costs will be ignored.

4. Initial equipment and programs. Included in this category are the costs of equipment (including test equipment) that must be purchased and program materials that must be produced or acquired to implement the system.

Costs classified as operating costs include all purchases of goods and services that have a useful value of less than a year or that are incurred every year. The following items are considered as operating costs.

1. Operation of equipment. Costs related to the operation of equipment are divided into these categories.

Salaries of operating personnel (professional and/or technical)
Annual cost of heating, air-conditioning, lighting, other utilities, etc.
Consumable supplies

2. Maintenance of equipment and facilities. Most maintenance costs are calculated as a percentage of initial equipment cost. Equipment maintenance will usually average about 10% of purchase price and includes such items as replacement of spare parts, replacement of test equipment and tools, and some portion of building maintenance cost where applicable.
3. Training. A continuous training program is necessary due to changes in personnel, methods, and equipment. Costs must be estimated for activities usually associated with continuing training programs.
4. Administration. Administrative costs vary with size and usage of the media system. Total costs of salaries increase at a somewhat linear rate as the system increases in size. Communication costs such as travel, telephone charges, and mail tend to expand rapidly as the size of the system, its complexities, and area of coverage increase.
5. Related materials. The operation of any media system requires the use of printed material to provide directions, schedules of events, guidelines, lesson plans, etc. The cost of this material is closely related to the number of hours of unique programming and the total number of users in the system (teachers and students). A cost for each unique hour of programming can be assigned and then extrapolated over a number of users as the system size increases from school district to state or region.
6. Current programming. This category covers the expenditures necessary to produce material other than those related to revision and modification of instructional programs. Included are announcements of school or community activities and materials for meeting, conferences, and special instructional projects.
7. Research, Testing and Evaluation, for Program Updating. A cost must be assigned to measuring and evaluating the operation of each media system. There must be an evaluative feedback within the system in order to properly operate and improve the system. Testing and restructuring the materials is one part of this process. This cost varies with student population, number of subjects offered, and intensity of media usage. Some of the costs will arise from the following activities:

Test development and research
Testing
Evaluating
Revision of materials

The cost of actually remaking the program materials, as indicated by the research, is included in the programming cost, since this cost is incurred, on the average, every five years.

Equivalent Annual Cost: To simplify cost comparisons, the capital costs can be amortized over the life of the investment and added with interest to the average annual operating cost to form an equivalent annual cost. The result is a uniform yearly figure which includes amortization and interest. These costs can be examined for each environment to determine cost trends as they relate to student population, area serviced, etc. To calculate the equivalent annual cost, first a capital recovery factor (c.r.f.) is obtained from standard financial tables for a particular interest rate and life of the purchase. For example, the c.r.f. for five years and 1% interest is a little over 20%. The capital cost is multiplied by the c.r.f. and the product is added to the annual operating cost to obtain the equivalent annual cost.

Cost Structure Model

A cost structure can be established which encompasses the capital and operating costs for production, distribution, and reception for each system in each environment. This cost structure is illustrated in Fig. 3.

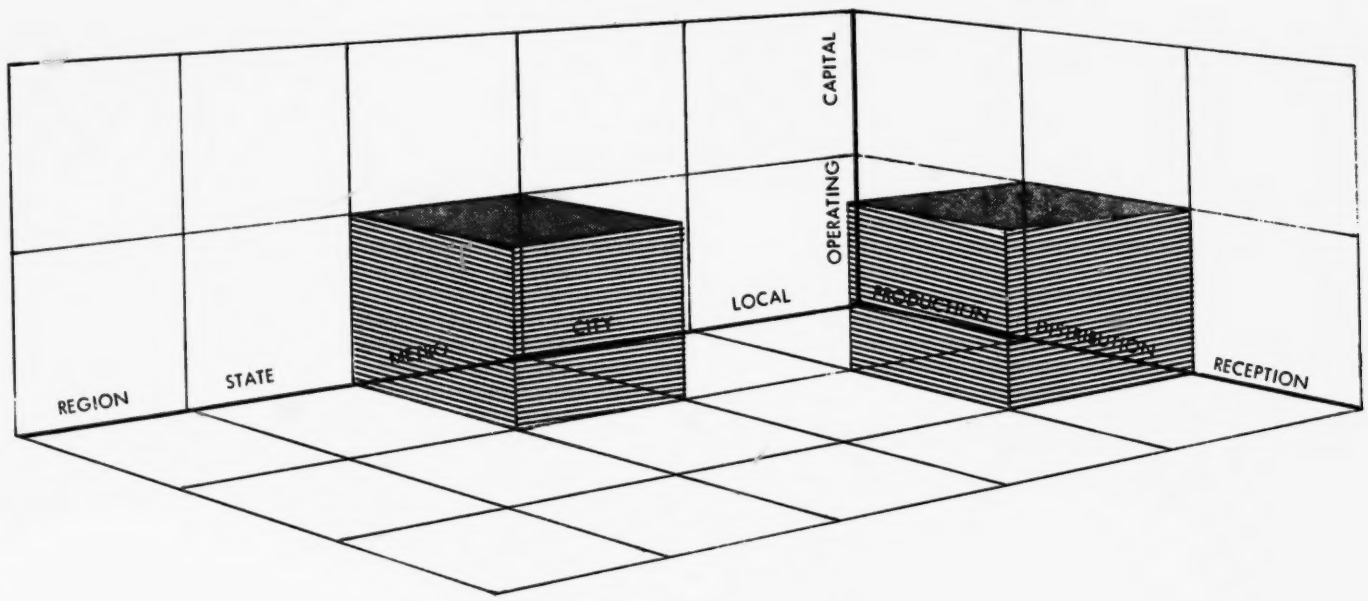

Figure 3. Cost Structure Model

Cube "A" illustrates an area of costs which is associated with the operating expenses during the production (acquisition) of educational material to be used by a media system in a metropolitan school environment. Cube "B" is symbolic of operating costs for distributing instructional materials within a local school district.

Sources and Use of Cost Data

The collection of cost data pertaining to an element of a media system usually resulted in a range of costs, not a precise value. The costs were collected from the following sources: equipment catalogs, reports (both objective and subjective), private conversations, and personal experiences.

The sources of cost data are indicated in most cases in the full original report, but there are some instances where the source is not mentioned. These data costs are derived from the experience and personal investigation of the project participants. In those cases where the numbers presented need to be qualified, the type of interpretation which should be placed on their value is indicated.

To estimate total costs for the systems investigated, a single value for each item was selected from the range of costs collected. The choice was usually based on intuitive feeling of appropriateness for the environment. In most cases, the value selected might be the mode of the frequency distribution of selections by purchasing agents under the given conditions. The assumptions which were made to derive the estimated costs are included in the report as the need arises.

The actual dollar cost per system may not be directly applicable to a specific educator's unique problem, but it can indicate general cost trends. The value of this cost structure lies in the generality of its approach. The variables of a real situation can be applied to the structure to provide more realistic comparisons for an actual situation. The cost structure might be looked upon as a tool which can be applied along with measures of "media effectiveness" to solve "real world" problems.

COST ESTIMATES

Costs were estimated for each of the media systems investigated using the basic model discussed in the previous section. (The detailed cost data are presented in the original study, available from the ERIC Document Reproduction Service.)

Graphical illustrations have been prepared from the cost data. There are two major sets of graphs presented and discussed in the full report. Each graph in the first set presents the production, distribution, and reception costs for one instructional media system. A second set presents graphical comparisons of the costs of media systems. Production, distribution, reception, and total costs are shown individually. (In this abridgment, detailed estimates are provided only for television, but comparisons between the different media systems are included.)

The following graph presents the production, distribution, and reception equivalent annual cost per student, i.e., annual operating cost plus amortization with interest. The cost per student is shown over the range of environments. The environments are listed across the bottom of the graph. Each of the five environments has a given number of students and the costs have been estimated only at these five points.

Television Production Cost

Fig. 4 presents the equivalent annual production costs, operating plus amortization, used for each television system. The production of instructional television materials can be treated independently of distribution and reception, and it is, therefore, presented and discussed before the individual television systems are presented. Three different costs for production of materials are shown.

Minimum Production Cost: This is the minimum estimated cost of producing usable instructional television material. It is based on a $300 per hour basic production cost plus a fraction of a rental cost of $145 per hour plus associated costs of administration, related materials, and research and evaluation. (Complete figures and rationale are shown in the full original report.)

High Quality Production Cost: This is an estimate of the costs of advanced state-of-the-art production based on $5,000 per hour production cost and rental at $145 per hour plus associated costs of administration, related materials, and research and evaluation.

National Programming Source Costs: This cost assumes that a national center provided copies of materials at a figure approaching the duplication cost. No such source of instructional material now exists.

The number of hours of programming in the model increases from 1,000 at the local level to 1,600 at the regional level.

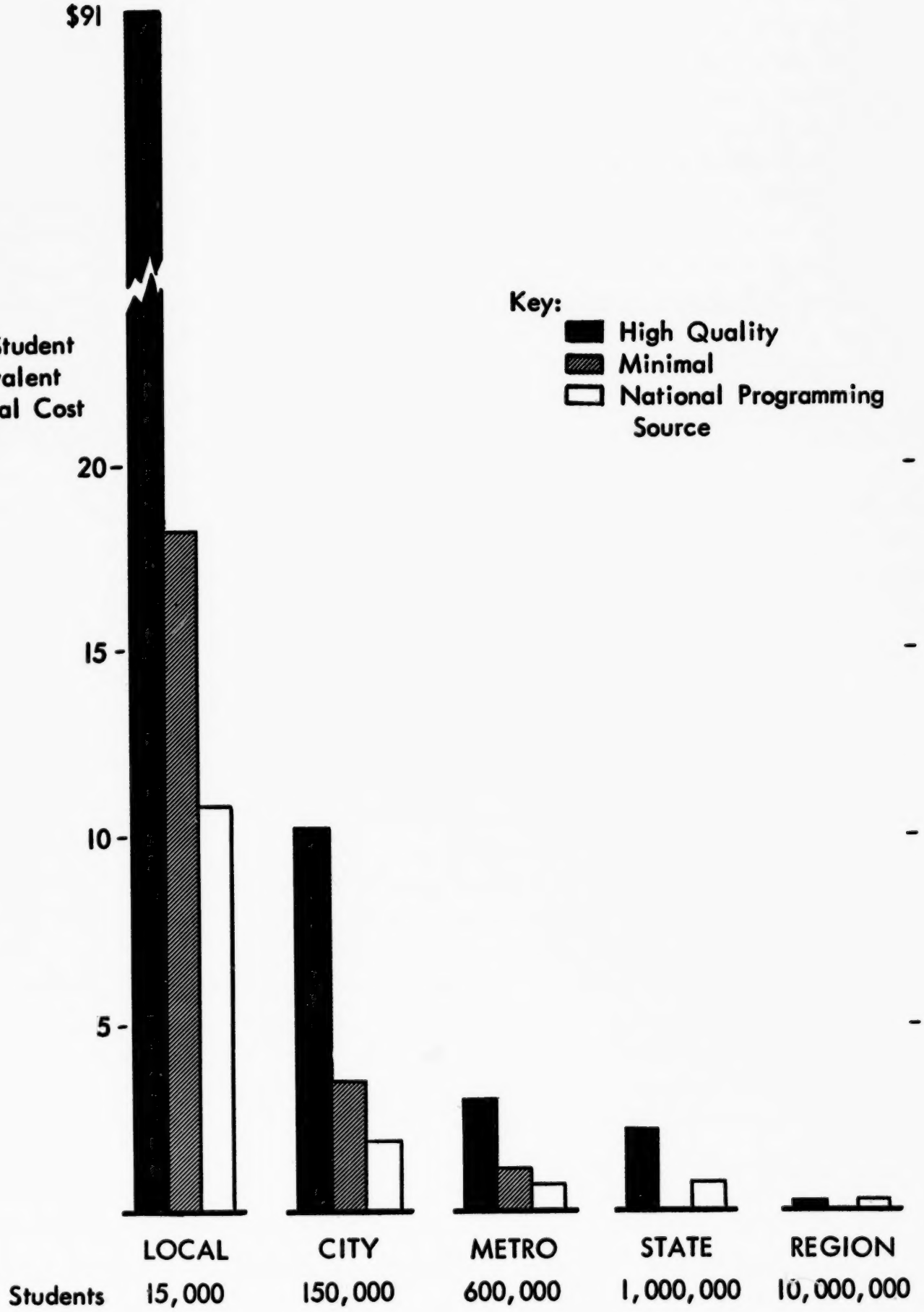

Figure 4. TV Production Costs

The costs shown in Fig. 4 indicate that the cost of high quality production is $91 per student, which is certainly beyond the funding ability of a local school system of 15,000 students. The minimal programming cost for such a system is about $18 per student per year, which is still a large figure. Therefore, the minimum programming costs were used in the model for the local and city school systems. Although it would be desirable to offer the high quality materials in these schools, no school systems are presently able to do so. (If a different estimate of the cost is desired, the reader can substitute either the high quality or the national programming source costs shown in the tables in the full original report.)

The most important observation concerning production costs per student is that the cost decreases rapidly as the number of students increases. This behavior is typical of a fixed cost. The costs in the production category of the model are mostly those of producing the television programs. This programming cost has two variables, price and quantity. Quantity increases as larger areas are served. The increase in program hours is necessary because a wider range of students is encompassed by the larger system. An increase from 1,000 hours for the local environment to 1,600 hours for the regional environment was assumed in the model. Unfortunately, it is very difficult to estimate how large the increase should be. Even if it were 300%, the the production cost for the largest system would be less than a dollar per student per year. The price of materials for the larger environments has not been increased directly, but the percentage of rented materials was decreased slightly. Fewer rentals means increased costs because rental is less expensive. In practice, the amount spent per program does seem to increase with the size of the area served, in contrast to the constant cost per hour assumed here. This is mostly a budgetary effect. Larger shcools have more money, but since their programming is almost always below the "high quality" level, they spend more per program whenever funds are available. Since high quality production is provided in the model, no such increase is needed here.

Looking at the annual production costs per student, it is encouraging to find that high quality materials can be produced for under $11 per student for all areas of city size or greater. If minimum programming is acceptable, even school systems of 15,000 can produce materials for under $20 per student per year. There is at least one system in the U. S.—the Washington County, Maryland, system—which is spending that much for programming. Finally, if a national center for copying a large supply of good materials were available, the programming cost would be about $10 per student for the local school and would decrease to only a few dollars for larger areas.

The production cost figure points to the need of school systems to cooperate in obtaining instructional television materials. It appears that any one school system will have great difficulty in financing its own production at any but a minimal level. Schools should join together in a cooperative production effort. It seems strange that no sizeable amount of cooperation in producing materials for physically separate

distribution systems has taken place. The most obvious reason that cooperation has not been practiced is that each system has different problems and its materials reflect those problems. On the other hand, thousands of school systems use the same textbooks.

Equipment for Television Reception

The reception cost for each individual school must be computed before the actual reception equipment costs for a school district can be determined. The costs vary with the size of each school. An average cost per school could be obtained which would produce a fairly accurate cost extrapolation over areas larger than a single school district. This study will use two average costs, one for a small school (elementary) and one for a larger school (secondary). This method is used to illustrate that some costs vary with the number of television sets in use, and some costs are somewhat independent of this number.

The enrollment of the smaller school is 500 to 700 students. It contains 20 or more classrooms, and 20 rooms are wired for television reception. However, only 10 are supplied with television sets. This allows for future expansion or the use of portable sets which can be moved from room to room as needed. Ten television sets in this size school are adequate for the common task used throughout this study.

The larger school's enrollment is 1,000 to 1,500 students. It contains 40 or more classrooms. Thirty-five rooms are wired for television reception, and 20 rooms are supplied with television sets.

Television sets, stands, wiring of distribution coaxial cable, and a distribution amplifier are the basic reception equipment in all of the television systems. To the cost of the equipment is added the particular equipment costs which vary from system to system. Thus, the difference in reception equipment costs for each system consists mainly of the differences in antenna, preamplifier, tower, and converter costs for each system.

Standard 525 line 23-inch monochrome receivers are used throughout all of the systems. All of the system also use radio frequency distribution within the school building. No consideration is given in this study to special high resolution television systems using video monitors operating with rasters of more than 525 lines such as might be required in a medical school.

Included in the hardware costs are the costs of installation, sighting of antennas, and system checkout. For airborne and ITFS reception, the cost of an *average* tower has been included. Thus, some schools would actually have higher or lower reception costs. All reception costs are based on four-channel operation. Operation of fewer channels would not significantly reduce reception costs.

Brief Descriptions of T.V. Media Distribution Systems

Airborne T.V.–C-130 aircraft equipped with video tape recorders and transmitters would provide four channels of UHF television coverage over about a 200 mile radius for the state. Eight such systems would be required for the region.

ITFS–Four channels of standard Instructional Television Fixed Service equipment would provide service for the local and city environments. Five such stations would be connected by off-the-air pickup for the metropolitan system. The state and regional systems assume the use of a proposed higher-powered ITFS system with microwave relay between six stations for the state and 73 stations for the region.

UHF Broadcast Stations–Four channels of standard UHF broadcasting equipment would provide service for the local, city, and metropolitan environments. For the state and regional environments, microwave relay of the signal from a central point to each of 20 stations for the state and 154 stations for the region is assumed.

Closed Circuit T.V.–Coaxial cable and microwave facilities would be used to connect each school with a central distribution center.

Satellite T.V.–A synchronous satellite equipped for four channel broadcast was derived from the computer model of G.E.'s Missile and Space Division. This model was based on 1973 projected technology.

VTR–This system assumes that each school is equipped with 4 helical-scan video tape recorders and a complete library of tapes.

Brief Descriptions of Other Media Systems

Film or Audio-Visual Media System–Equipping of each school with 16 mm. sound projectors and a minor amount of equipment for slides, filmstrips and tranparencies is assumed. Film prints are purchased by a central facility and circulated to each school by truck.

Educational Radio–A four-channel FM multiplex system would broadcast from separate stations, each obtaining tapes from a national production facility. Each school room is equipped with a receiver.

Learning and Language Laboratories–For the local and city environments, a 30 station interactive audio facility for languages at each high school and a 30 station non-interactive audio facility at each elementary facility is assumed.

Dial Access–The dial access system would consist of a central bank of audio tapes prepared by the teacher which can be presented over a classroom speaker upon demand in any classroom.

Comparison of Costs

The following graphs illustrate the equivalent annual cost per student of the production, distribution, reception, and total cost categories for all media for each environment. These graphs are used in discussing the cost comparisons of the media systems.

Production Costs

Fig. 5 shows annual equivalent production cost for each media. The cost for production of television and film per student per year is quite high, but the production cost for television decreases rapidly from \$18 to 25¢ as the number of students is increased. Recall that programming is the major portion of production cost. At the local and city levels, low-cost programming for television was chosen for the model while high quality programming was specified for the larger areas. In contrast, because of present film print pricing practices, the film cost for production does not decrease with higher numbers of students. It increases from \$37 to \$46 per student per year. The increase reflects the increase in the number of programming hours from 1,000 at the local level to 1,600 at the regional. The present pricing practices do not reflect the large increase in volume which is incorporated in the model, and might well change if an increased volume of prints were assured. Nor do the present pricing policies take into account the possibility of producing coordinated series of lessons with a simpler instructional television format. These would probably cost considerably less per lesson. On the other hand, to change these practices would lead to abandoning of one of the peculiar advantages of film, i.e., the ready availability of a wide range of materials of high technical quality.

The costs for radio production are somewhat high, about \$4, at the local level, but decrease rapidly with larger numbers of students. The cost for the metropolitan and other areas is approximately \$1 and less. The costs are based on rates higher than the present cost of obtaining duplicates for the Educational Audio Network. The increased rate provides funds for producing new series of instructional materials. The radio production costs also include costs for noninstructional broadcasting of about \$1 per 100 persons in the broadcasting area. The radio production costs are much lower than the television production costs.

The production costs for language learning laboratories, around \$2 per student per year, is not strictly comparable to the production cost for the other systems. The language laboratories can occupy 10% of the student's time without 1,000 hours of unique programming, which is the amount of programming assumed for other media at the local level. Nor is it at all obvious that the student should spend 10% of his time using a language laboratory. Therefore, a figure of 225 hours of unique programming has been used in the model. The elementary schools are assumed to use a passive or

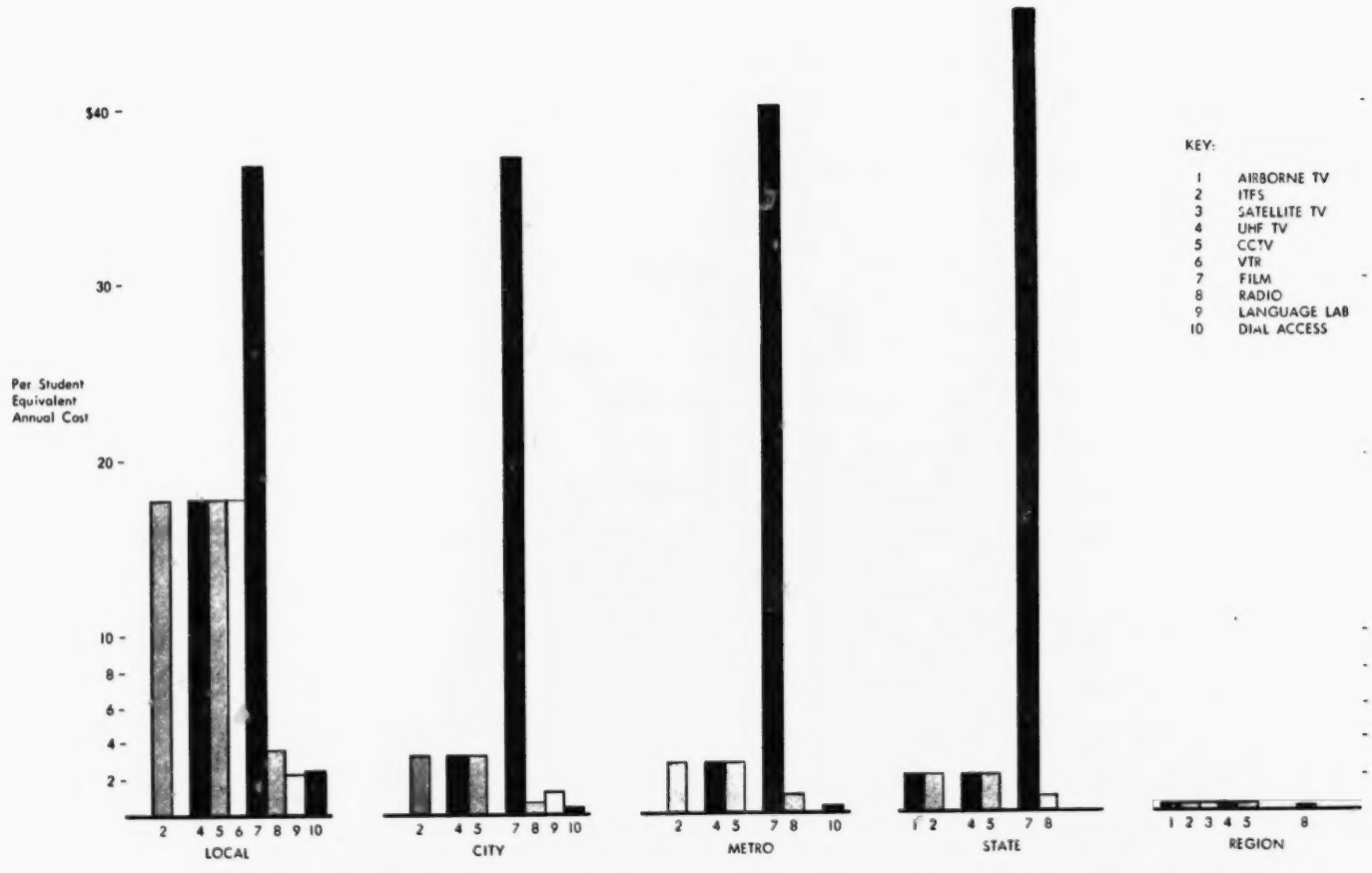

Figure 5. Production Cost Comparison

listening–only system. Only a small amount of money has been made available for programming for the elementary schools.

The production cost for the classroom dial access system is quite low, i.e., $2 at the local level and considerably less than 50¢ at the city and metropolitan levels. The production cost includes 1,000 hours of tapes of various readings, events, music, etc., which are presently available at a low cost of about $10 per hour. Because the system has 67 channels, and because of the general nature of the material, the instructional technique would largely consist of selecting short segments of the materials by the teacher. The teacher would assemble an instructional sequence for a particular class. This is quite different from the production of radio or television materials where the more limited number of channels assumed in the model means that most of the materials would be organized into complete instruction sequences by a central facility.

In summary, it can be said that production for visual materials can be accomplished at the reasonable cost of several dollars per student if the number of students in the system is in the hundreds of thousands. Moreover, the price structure for the materials must reflect the large volume. At present, television production cost is considerably less than the cost of producing films.

The production cost of audio materials for the 10% task is less than $1 per student when the number of students reaches the level of 100,000. If teachers produce their own tapes or if the somewhat limited number of tapes now available is used, the cost is only a few dollars per student even at the local level. Each of the audio methods is inexpensive to program at the city level.

Distribution Costs

Fig. 6 presents the equivalent annual cost of distribution for each instructional media system. The costs of many of the systems which were examined across the entire range of environments show the same type of behavior, i.e., decreasing cost per student in the range from local to city and metropolitan area and then an increase from the metropolitan to the state and regional levels. The change in the number of students per basic transmitting unit of the distribution system causes this behavior. The city and metropolitan areas have densities on the order of 1,000 students per square mile, while the state and regional densities have less than 50. In general, the higher the cost of the basic unit, for example a radio transmitter, the higher the cost per student for the local area but the lower the cost for the larger areas. The local area does not utilize all of the larger systems' potential.

The television distribution systems are relatively expensive to use for the local school system, but become quite reasonable for the city and larger areas at about $2 or less per student per year.

The lowest-cost television distribution systems are the present ITFS for local, city, and metropolitan area coverage and the new proposed higher-powered ITFS system for the state or regional areas. The UHF and closed-circuit systems are only $1 per student per year more than ITFS at the city level. It should be noted, however, that the costs for this new type of ITFS equipment are conjectural, since none has been produced or operated. Also, almost all of the cost difference between UHF and the proposed higher-powered ITFS is due to higher power, more attention to providing a readily available signal, better control and monitoring, and higher operational reliability of the UHF system. The two systems are almost the same from a technical standpoint. It would be feasible to change either service to more closely resemble the other, although the FCC would have to approve such changes.

The projected 1973 satellite costs of a little under $2 per student per year and the airborne cost, which is slightly more, are roughly competitive with the higher-powered ITFS system for larger areas. The cost of the airborne system declines from state to region because the coverage patterns fit together better in a larger area.

The VTR system which places a video tape recorder and tape library in every school is quite expensive, about $36 per student per year. The cost would not decrease for larger areas since the basic cost is multiplied for each school.

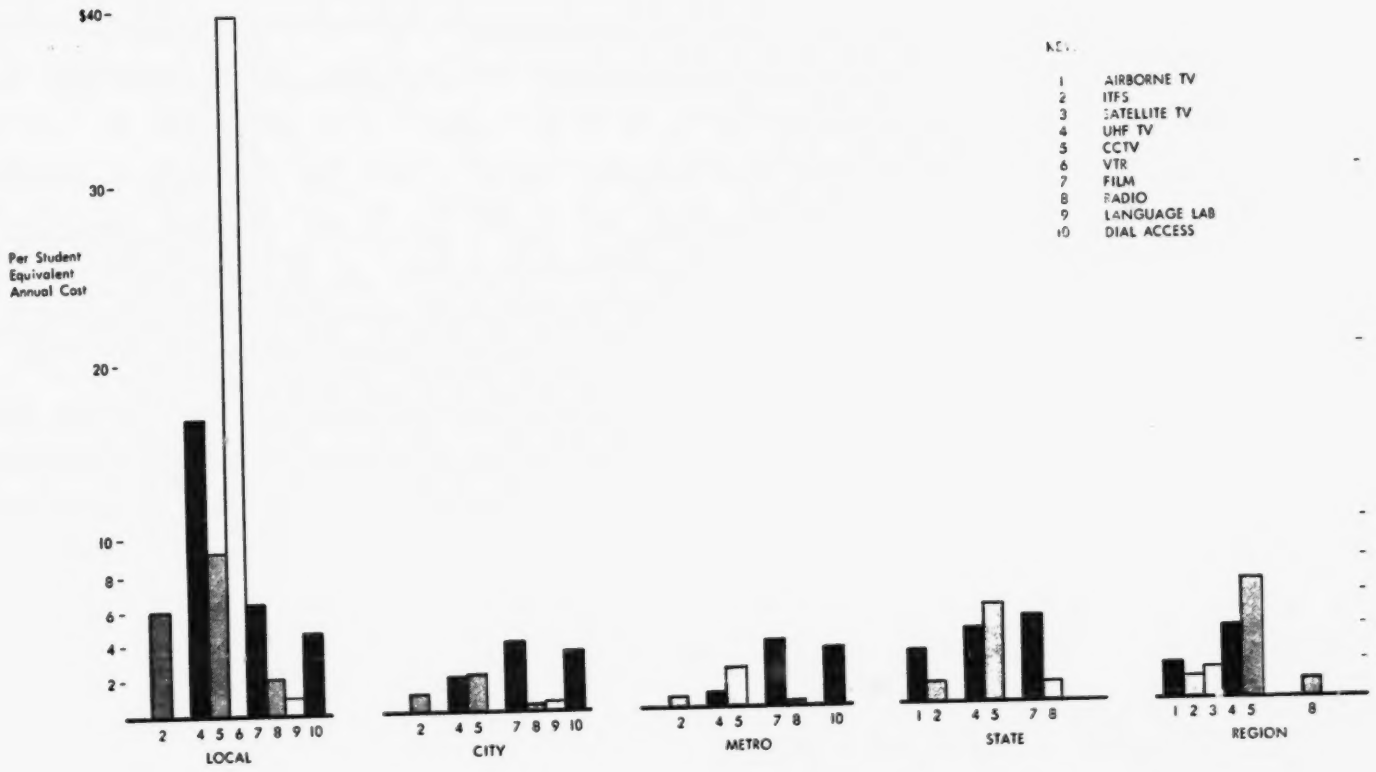

Figure 6. Distribution Cost Comparison

The radio distribution system is even cheaper than television, particularly at the local level where it is only $2 per student per year.

The language laboratory distribution system costs about $1.50 per student per year for all of the environments for which it was costed.

The dial access distribution system is the most expensive audio system at $3 to $5 per student per year, ranging from the local to the metropolitan areas. The dial access system was not investigated for state or regional areas, but the costs would probably increase substantially because of increased transmission line charges.

The film distribution system costs about the same as dial access or closed-circuit television. The costs are in the $3 to $6 per student per year range.

In summary, television and radio are both available for the city and/or metropolitan areas at less than $1 per student for distribution. In the local school district, the distribution cost of the language laboratory and radio system is considerably less than any other system, about $2 per student per year. The radio system is a high-powered service which can serve homes as well as schools 18 hours per day. Film or classroom dial access distribution can be accomplished for $3 to $6 per student per year depending upon the size of the area. The VTR in the school is not an efficient method under the assumptions presented in the model. Among the television

systems, for distribution cost alone, the ITFS system is cheapest for the local and city areas. For the larger areas, only a change in FCC rules to permit higher power will allow ITFS to be competitive with UHF or airborne for the state and region.

It should be noted that effectiveness has not been studied, and that some of the fairly small differences in distribution costs may be offset by educational advantages or disadvantages.

Reception Costs

The equivalent annual costs per student for reception are presented in Fig. 7. The reception costs show a more constant behavior pattern as a function of area size than do the other costs.

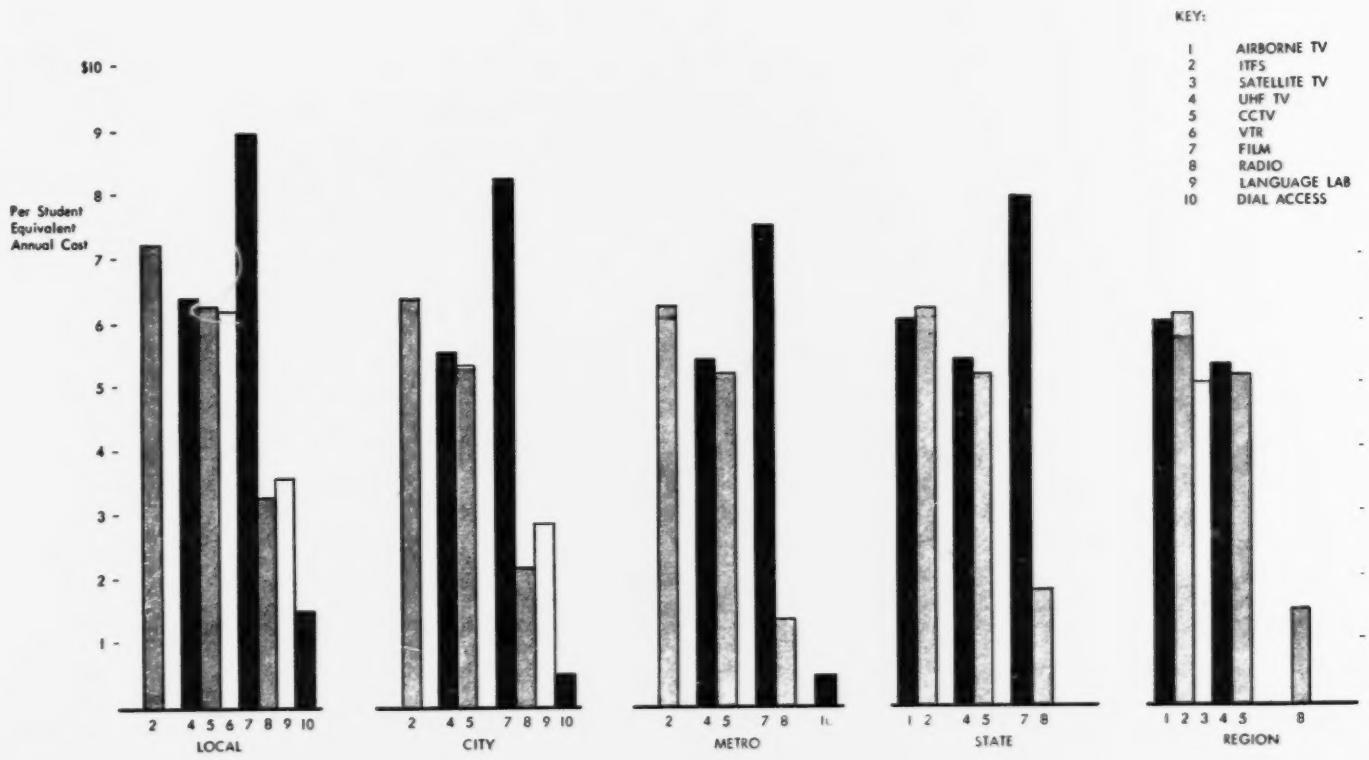

Figure 7. Reception Cost Comparison

The television costs fall in a band about $1 wide centering on $6.50 for the local system and decreasing to $5 per student per year for the regional system. Closed-circuit, VTR, and UHF broadcasts have the lowest costs. Airborne and ITFS have the highest costs because better antennas and towers are needed. The reception costs for the satellite system are projected at slightly less than the others because 1973 technology is assumed for this system. The present cost for this equipment would be considerably more. Approximately $2.50 of television reception cost per student is for teacher training and another $2 is for the television set.

The radio reception cost decreases from about $3 per student at the local level to about $1.50 per student per year at the regional level.

The film reception cost is about $9 for the local system but decreases to $8 per student per year for the metropolitan area. Film reception costs is the highest of all the media, but is only insignificantly higher than the television reception cost for the metropolitan area.

The language learning laboratories reception costs are slightly higher than radio reception costs because they include the carrel.

The reception cost for classroom dial access is the cheapest of of the media–less than $1 per student per year at the city and metropolitan level. The dial access reception equipment consists of one loudspeaker per room.

In summary, television reception cost–including $2.50 for teacher training–is about $6 per student per year. The reception cost for closed-circuit or VTR network is slightly more than for the other television systems. Film reception cost is somewhat more. The reception cost for radio is about $2 except for the local area where it is about $3 per student per year. The reception cost for the language laboratory is slightly more than for radio. The classroom dial access cost for reception is very low, about 50¢ for the city or the metropolitan area.

Total Cost

The total equivalent annual cost per student is shown in Fig. 8, and is perhaps the most important cost of all.

The total costs fall into two broad bands with only a few exceptions. The television total costs (except for the VTR system) fall between $30 and $40 per student per year for the local area (5% to 10% of yearly expenditures). They converge on $10 for the city and roughly the same for the metropolitan area. They then spread to a range of $6 to $14 for the state and regional areas. The 1973 satellite has the lowest total cost but only by an insignificant margin. The ITFS system is less in the local areas. For the city and metropolitan areas, costs are so close that technical questions of channel space would probably be more important and would no doubt favor the closed-circuit system. Much the same can be said for statewide multichannel systems unless FCC rules are changed.

The results for the audio systems, language learning laboratories, classroom dial access, and radio systems form the second band and all fall in the $8 to $10 range for the local area and in the $3 to $6 per student per year range for the city. The radio system is about $2.50 per student per year for the metropolitan area and $3.50 and $2.50 for the state and region, the lowest cost of any system.

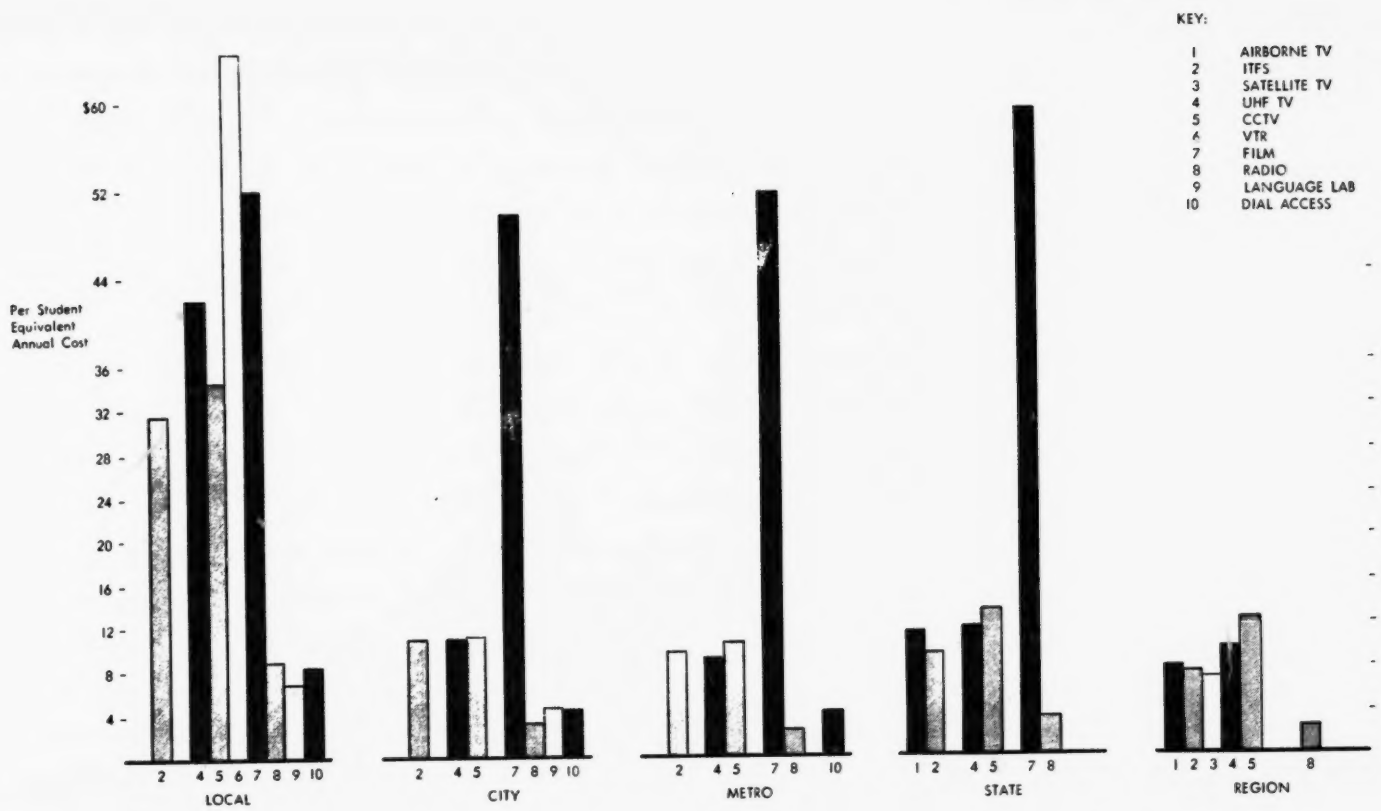

Figure 8. Total Cost Comparison

The VTR system with video tape recorders in each school costs about $65 at the local level, considerably more than any of the other systems. As cheaper and more reliable machines, high speed duplication, or the CBS Laboratories' EVR system become available, VTR should be given additional attention.

The total costs for film are about $50 per student for the local, city, and metropolitan areas, but rise to about $59 per student per year at the state and regional level.

In summary, audio instructional materials can be supplied by radio for as low as $2 to $3 per student per year. Visual material costs are about $10 per student per year when they are delivered by television in the city or metropolitan areas. Several new methods are available for coverage of wider areas at about the same or slightly lower cost. Smaller school districts must cooperate with one another or pay considerably more.

Effect of Number of Channels and Task Size on Cost Per Student

The cost figures presented in the discussion of television and radio have been costs for a four-channel service. The four channels accommodate the defined task of 10% of student time with a considerable margin for repeated broadcasts and expansion.

There is, of course, the possibility of changing the task and/or changing the number of channels. An estimate of the cost of doing this is shown in Fig. 9 and Fig. 10.

Fig. 9 presents the change in cost with a switch in the number of channels from four to two and one for selected television systems. The figures are obtained from those in the descriptions using the same production and reception costs per student and the distribution costs for one and two channels. It is assumed that a single six or eight-channel converter to UHF can be designed. The additional cost is quite small, little more than $1 for six or eight channels. Regulatory limits on the number of channels might preclude such additions, however.

Fig. 10 considers the effect of a change in the level of the task accomplished by the instructional media system. The basic level of the model is 10% of student time. For a 20% task, the programming portion of production cost would almost double. Other costs would remain about the same. The result, roughly a 20% increase in total cost, is shown in Figure 18 for the closed-circuit metropolitan system. Other television systems at the metropolitan level would change the same amount, given the above assumptions.

A combination of the two changes—a 20% task and an eight channel system—would result in an increased cost of only about 30%, but this is only a very crude estimate.

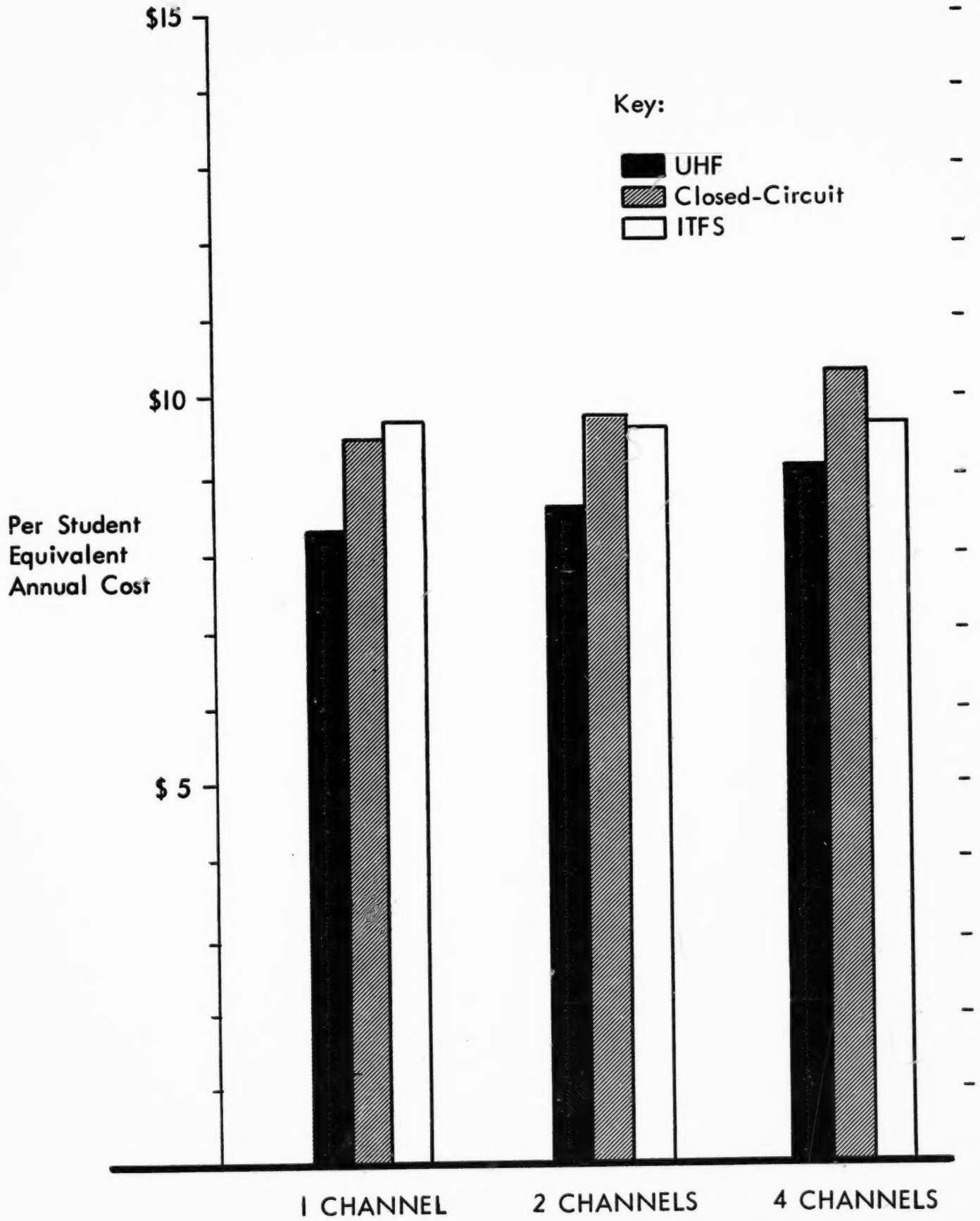

Figure 9. Estimated Effect of Number of Channels on Cost–Metropolitan Area

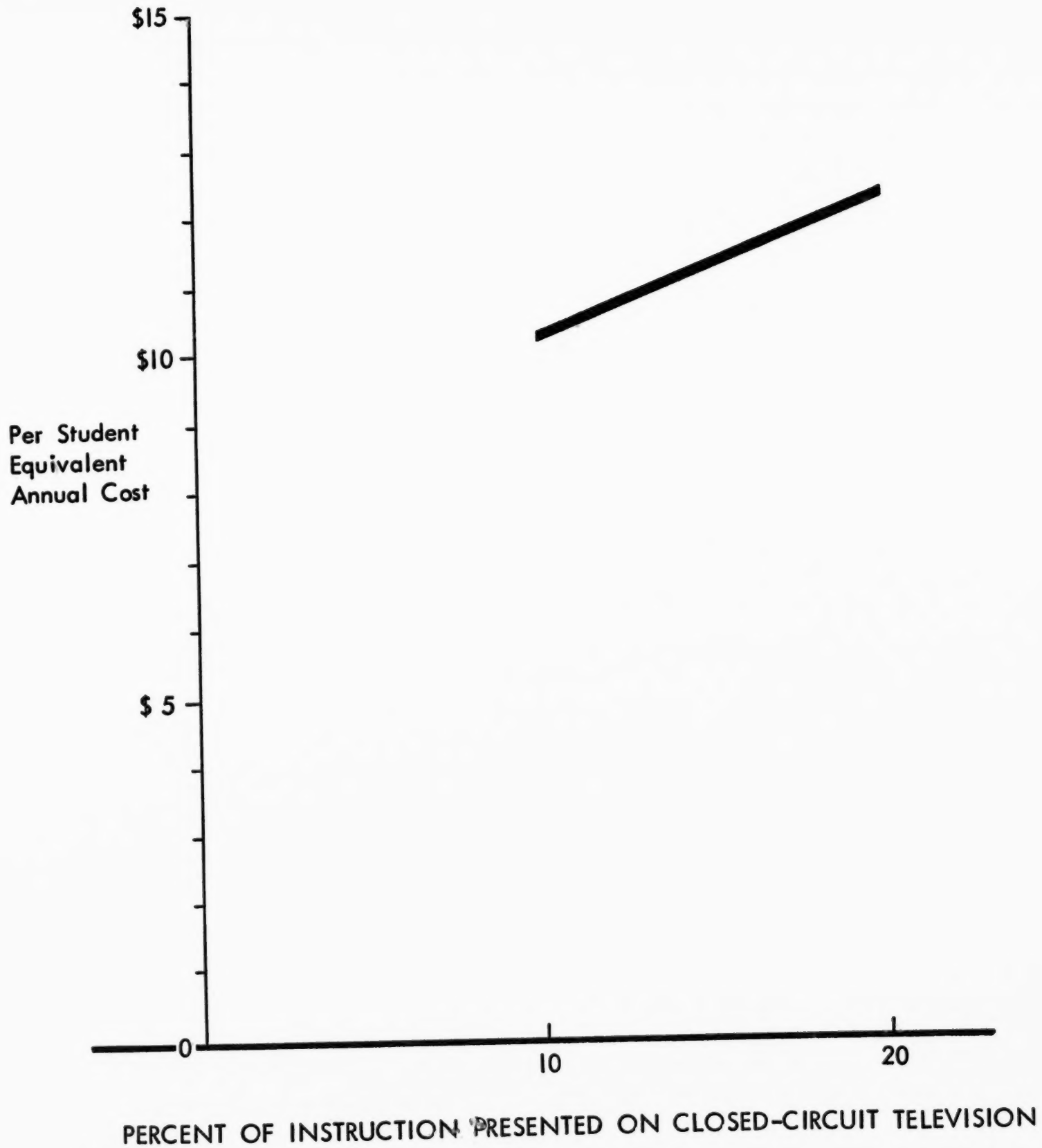

Figure 10. Estimated Effect of Task Size on Cost–Metropolitan Area

COST-SAVING CONSIDERATIONS

One objective of this study was to investigate ways in which costs in instructional media systems could be reduced. This section serves two purposes. The first is to present an overview of how cost savings may be achieved, the second to present suggestions which may lead to possible cost savings through organizational changes in the educational systems.

Three areas can be identified where changes are necessary if cost saving are to be achieved:

1. The utilization of media systems,
2. The technology of media systems, and
3. The organization of educational systems.

A discussion of each of these three areas is presented in this section.

Utilization of Media Systems

Wide-scale adoption and more intensive use of the media will result in cost reductions on a per student basis in the areas of production, distribution, and reception, as discussed below.

Production Cost Savings from Increased Utilization

Significant savings will result if a production effort can serve a larger number of students. However, if materials are to be accepted for widespread use, the quality of content and presentation must be improved by making more effective use of learning theory, techniques to motivate students, and studies of the curriculum needs of the schools. Preparation of materials in this manner would result in an increase in overall production cost but, through wider utilization, would also result in a decrease in production cost per student.

Savings in quality production are predicated on the assumption that the need for materials is relatively uniform in widely scattered school districts and that reliable, convenient distribution and reception systems would be available to transmit these materials. The existing widespread adoption of the same textbook would seem to indicate that these assumptions are reasonable. However, some coordinating mechanism is needed to guide the production and distribution of materials for the newer media. The cooperation of school districts is an essential ingredient in the development of such a mechanism.

Fig. 4, earlier in this abridgment, illustrated the cost savings possible through wider utilization of the materials produced for television. The cost per student drops

rapidly with the increase in the number of students served. This cost decrease occurs although there are two assumptions in the model which would tend to have the opposite effect: (1) the number of hours of material required increases 60% from the local to the regional environment, and (2) the quality of material changes from "minimum" at the city level to "high" at the metropolitan level.

Distribution Cost Savings from Increased Utilization

The distribution cost per student can be reduced if

1. More students can be served from a central facility, or
2. Mass reproduction methods can be found for making inexpensive copies of original materials.

The service of a media system can be increased through the use of network television techniques–higher transmission antennae, increased transmission power, and the electronic relay of materials between school districts. Satellite and airborne television systems are also well suited to covering vast areas containing large numbers of students. More intensive use of such methods can reduce per student cost considerably, but only if materials and schedules are appropriately tailored to the educational needs of participating schools. To accomplish this, transmission centers must have multiple channels available, and schedules and materials must be coordinated with the schools.

Fig. 11 shows the behavior of distribution cost for broadcast television systems as a function of the number of students served. The cost per student decreases sharply over the range from the local to the metropolitan level. On the other hand, no decrease occurs from the state to the regional level because the population density does not increase; in other words, the utilization of any one station does not increase from the state to the regional level.

The critical factor in lowering the cost of reproducing original materials is the anticipated volume of distribution. Unless the volume is large enough, the development effort required to find inexpensive methods of duplicating films and video tapes would not be worthwhile. Present copying techniques are based on high quality broadcast standards and low volume. Although high speed repoduction of video tapes is potentially possible, the necessary techniques have not been developed. The price of a film print is many times the cost of making the print because of the low recovery rate of production and marketing costs. Assurance of a high-volume market for copies of video materials or federal financing of the needed research would encourage low cost reproduction methods of copying video educational materials.

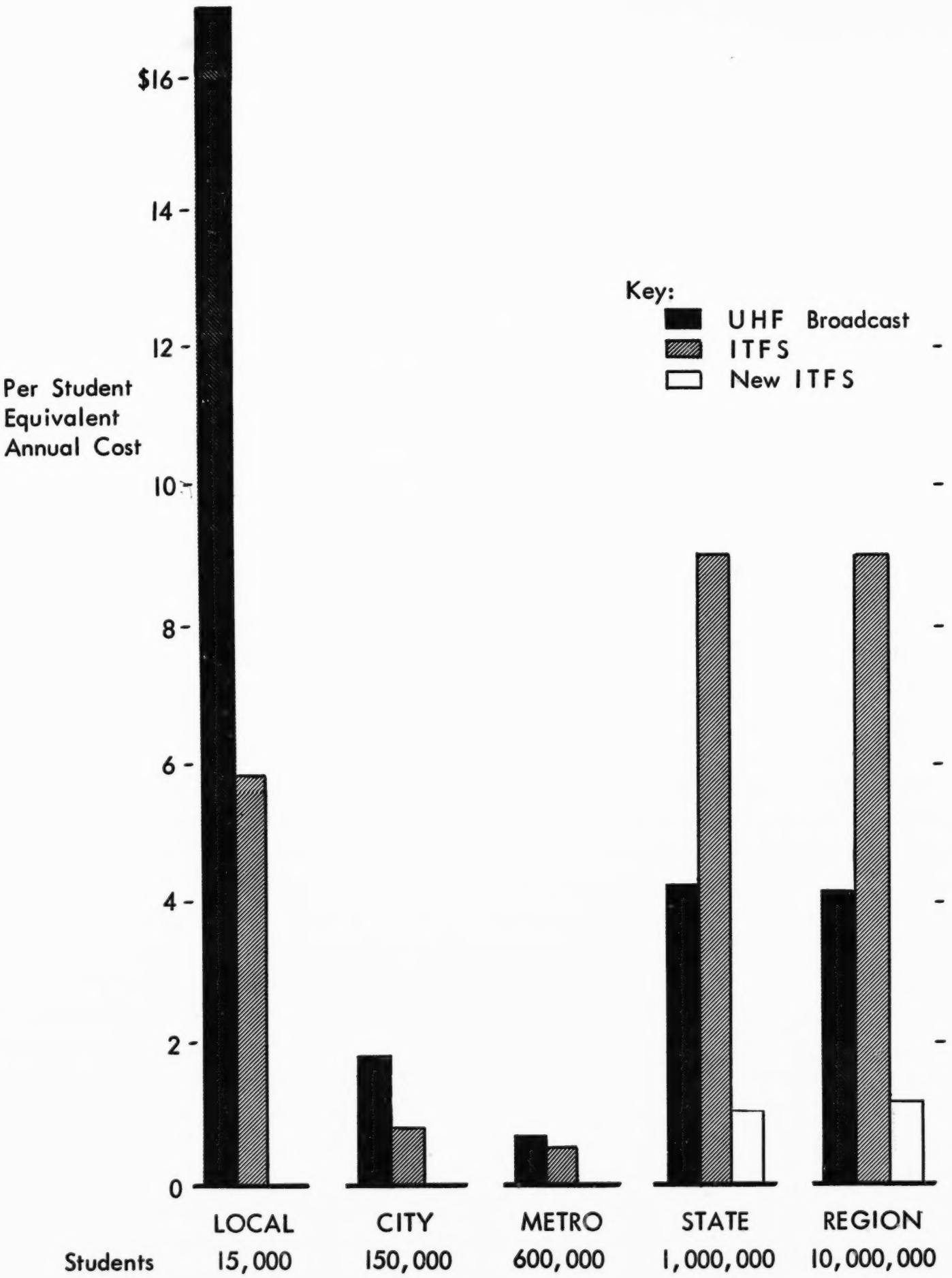

Figure 11. TV Distribution Costs

Reception Cost Savings from Increased Utilization

Savings in reception costs can be effected through

1. Increased student utilization of some portions of the reception system, and
2. Lower costs of components through the adoption of mass production methods.

Portions of the reception system would cost less per student if more student hours were devoted to the media. The central reception and distribution segments in the television reception systems are examples of areas where greater utilization would lower per student cost. However, since most of the reception cost is for the television set and teacher training, more students in the schools would not necessarily lower costs per student. The students would still need a television set and a trained teacher.

The discussion above shows that an increased number of students using a media system tends to lower per student costs. Also, there is another increase in the utilization of the media which would tend to affect cost favorably, i.e., the increased use of the system by the same students. Although the actual cost per student would rise as the system is expanded, the cost does not increase as rapidly as service is increased. Therefore, it total educational costs are considered, more intensive use of media systems may be desirable since the change in the cost of providing additional units of instruction is quite small.

Improved Technology for Instructional Media

Improvements in the instructional media technology should lower the cost of the media. Several technological advances are suggested in this volume. For example, the satellite system is not now in existence; the higher-powered ITFS system is a new proposal. The suggested use of a four-channel television system would also be an innovation. Some aspects of the classroom dial access and language laboratories are new, and the multiplex radio system is not now in educational use.

Organization of Educational Systems

The behavioral objectives and the types of learning associated with those objectives are key elements in the media selection process. The mode of presentation, whether group or individual, is also an important consideration in the selection procedure. If these elements play a part in the selection of a media system, it may be assumed that the need for both group and individually-oriented systems will be recognized. Would this change the traditional school organization? Yes, because there are few provisions for individualized instruction at the present time. Could these changes result in "cost saving" situations? Again the answer is "yes."

The cost savings which could result from changes in the organization of educational systems should probably be referred to as increases in "cost effectiveness." Most of the previous discussion has tended to equate cost savings with reduced costs. In this discussion cost savings will be equated with cost effectiveness.

The largest item in a school's operating budget is teachers' salaries. The implementation of media systems would not necessarily reduce the number of teachers. It would alter their role, however, so that they could devote a larger portion of their time to individual instruction and the guidance of learning experiences. This would be one step toward the achievement of optimum "cost effectiveness." The operation of media, the monitoring of learning experiences, and other similar responsibilities could be assigned to paraprofessionals. This work, currently performed by the teacher, could be effectively accomplished by persons without the professional qualifications required of members of the teaching staff. Hence, a "cost saving" may result when a school system is organized along these lines.

The discussion of wider utilization of media systems indicated the cost savings are possible when the system is used by larger numbers of students. For example, a dramatic decrease in annual cost per student for the production of television material occurs as the number of students increases from 15 thousand to 10 million. The per pupil cost of the distribution portion of the media system is also favorably affected as the number of students increases in the area served by the system.

Wider utilization may reduce cost, but it may also present organizational problems. For example, if 11 states were to be served by the same instructional satellite system, the educational programs of those states would have to be coordinated.

If production costs are to be shared, the material must be acceptable to all of the participants. Therefore, the user schools must be involved in the design, development, testing and evaluation, and revision of materials. The financial arrangements to support the production of materials must be agreed upon. All of the above considerations would affect the present organization of the user schools.

A distribution system which serves more than one school or district also presents problems. The scheduling of "what and when" can be a horrendous task. Again, the organization of the schools using the system is affected by the scheduling, so these schools must cooperate to determine the policies of a central distribution facility.

The media cannot be effective unless the teacher is trained to make use of the capabilities which the media system provides. Therefore, teacher training is of prime importance, and the educational system must provide adequate training. Teacher training may tend to increase per student cost, but lack of training in the use of the

tools provided by media can affect cost effectiveness immeasurably.

The scope of this report does not include the investigation of designs for the effective organization of educational systems, but this discussion has been included to point to some of the ways in which media system cost reductions and cost effectiveness are related to the organization of the educational system.

REGULATORY IMPLICATIONS

Electronic Systems

Some of the multichannel instructional television systems proposed in this study are not explicitly covered by the present regulations or policies of the FCC. Specifically, the higher-powered ITFS specified for the state and region, the four-channel UHF system, the UHF airborne system, and the use of satellites for direct transmission on the 2500 MHz frequencies are all somewhat outside established practice. These departures were made for two reasons, cost and regulatory tardiness.

The production costs for instructional media for the local school system of 15,000 students were found to be $60 per student per year for high quality programming, $15 per student for minimal quality programming, and $6.67 for copies of materials produced by national sources. The distribution cost was almost $6 per student, even for ITFS, which has the lowest cost. These high costs decrease as more students are served and should encourage schools to share production and/or distribution efforts by joining an area-wide system such as a metropolitan, state, or regional system.

The possibility of a wide area multichannel instructional television system is limited under present FCC regulations and policies. An examination of the policies regarding multichannel wide area systems shows that these limitations make it impractical to implement a large scale instructional television system outside of a metropolitan area. Existing regulations are examined below.

The UHF frequencies are designated as broadcast frequencies. The Communications Act of 1934 defines broadcasting as "the dissemenation of radio communication intended to be received by the public." The FCC regards this definition as separating instructional television from broadcasting since ITV is not intended for the entire "public." FCC policy is that instructional service, if designed for instruction alone, should not be placed in the UHF band. Multiple channels would be particularly hard to obtain for educational purposes. Recent FCC actions which give evidence of this viewpoint are the denial of the NAEB request for multiple-channel educational reservations in the latest UHF allocation table, the denial of the Georgia State Board of Education petition for a block of 30 UHF channels, and the refusal by the FCC to allow the airborne television project to continue using the UHF channels assigned to it.

The FCC has specifically allowed educators to use the 2500 MHz band on a shared basis with other users for a three year period ending in 1966. As of 1968, no final action has been taken. This service, the Instructional Television Fixed Service or ITFS, was set up at the urging of an electronics firm which desired an additional

market for its low power microwave relay transmitters. The service is low power, localized for individual school systems. Use of low transmitting heights and directional transmitting antennas is recommended. Paragraph 26 of the Report and Order on Docket No. 14744 of the FCC specifically bans use of ITFS "to distribute material over an entire state or a large portion thereof." Even when used within a metropolitan area, the FCC concept of shared use of ITFS channels has required the concurrence of all school districts in the area before service can be instituted. Such service is not economical for wide area coverage, as is shown in the standard ITFS cost figure for state coverage in the full original report.

The airborne system was given until 1969 to relinquish its UHF channels and went off the air in June 1968. Meanwhile the FCC designated six ITFS channels in the midwest for its use. Airborne broadcast on even four ITFS channels in any area except that covered by the midwest airborne project would have to obtain the explicit permission of all school districts within its area, according to the present FCC policy. This would be difficult.

The use of a satellite for direct telecasting is not covered by FCC regulations. There are strong political and eonomic forces that must be overcome before such an operation would be approved.

The only alternatives to the telecasting methods discussed above are closed-circuit systems and the portable video tape recorder, neither of which uses the airways. These are by far the most costly systems, as was shown earlier in Fig. 8. Neither of these systems is within the province of the FCC unless microwave is used or state lines are crossed.

In summary, the use of the airwaves for multichannel instructional television for a wide area has been almost precluded by present FCC regulation and policy. Since such a system has considerable cost advantages, several instructional media systems which would be difficult to establish under present FCC policies and regulations were included in this report. The systems which are specified can be justified in terms of channel allocation and the economics of providing the service if a priority were assigned for instructional service. A brief justification for each of the systems follows.

The four-channel UHF instructional system could be accommodated if the FCC would recognize the difference between instructional service and other broadcasting. The taboos–limitations on close spacing of channels–could be changed. The taboos were eliminated for ITFS in recognition of this fact. Reservation of a block of channels for instructional systems was thoroughly studied for the Georgia State Board of Education proposal and found to be practical. A block of 20 channels would be sufficient for a four-channel state or regional service. In the UHF channels 52-72 or 63-83, there are only the merest handful of broadcast stations operating. They could

be moved down into the region below 52 or 63 if some of the allocations to small communities were deleted from the allocation table or if a more "saturated" allocation table were prepared. It has been shown that the great majority of the UHF station allocations will not be used in the foreseeable future because they are not economically feasible. It has been said that the FCC is thinking of transferring a portion of the UHF broadcast channels to the land mobile service for this very reason.

The four-channel airborne system was generally assumed to be operating in the UHF in this study. However, it was noted that the transmitting equipment could be produced for about the same price at the ITFS frequency. Thus, the airborne system could operate at either frequency except for regulatory considerations. Extensive analysis of the allocations in the midwest in 1964 showed that there were adequate channels available for both a six-channel airborne instructional system and all the commerical stations which would be economically feasible in the foreseeable future. The same is probably true for all regions except the eastern megalopolis, which has been treated in a separate statement in the full original report.

The low power of the present ITFS system does not make it economically feasible for use in a large area. For this reason, a higher-powered, wide-area ITFS service is proposed in this study. The reason for examining the state and regional areas is because the local school system can not afford programming for the multichannel systems. A state or regional system is the only way to serve the small school districts if they are outside of a metropolitan area. While the local school system may find scheduling advantages in the use of ITFS, there are serious problems of financing the production of materials for telecasting. The FCC's recent pamphlet on ITFS points to the desirability of renting materials rather than producing them in each school system. Unfortunately, there are not adequate rentals available and even rental is expensive for the small school system. Many schools are proceeding with live production without adequate resources, personnel, planning or experience. Many thousands of schools will soon undergo the frustrating programming experience which ETV stations have experienced during the last 15 years.

The proposed higher-powered ITFS system would include a 20 channel block for the state or regional system, leaving four to six blocks of two or three channels per block within the present ITFS allocation for purely local use or for local retransmission to avoid scheduling problems.

The satellite system in this study is on the same frequency as ITFS. It is assumed that provision could also be made for a few channels of local ITFS service, as would be done with the higher-powered ITFS.

The problem of frequency allocation is currently under inspection by several groups on a national and international level. This is a particularly opportune time to make adequate provision for instructional televsion.

In summary, without a national program source, only a state or regional system can economically provide multichannel instructional television for the local school. The FCC does not provide for such a system. Therefore the assumption has been made that the regulations can be changed. It is suggested that economical and efficient four-channel systems can be instituted at either UHF or ITFS, leaving sufficient channels still available for local commercial and educational interests.

Film System*

Some cost efficiencies in a 16mm media system could be realized with a favorable outcome of the current copyright legislation. Unfortunately, Congress is trying to develop a piece of universal legislation that will satisfy both the author and the publisher of all art forms for all communication media, both commercial and educational. A proposed draft of suggested copyright changes was authored by members of National Association of Educational Broadcasters for the Department of Audiovisual Instruction of the National Education Association. The bulk of this draft was adopted as the official position of the NEA, which then recommended the changes to Congress. These recommendations have provoked considerable discussion during the past two years.

The fair use doctrine was expanded to permit a school to make one copy of a film without obtaining permission from the copyright holder, use it once, and then destroy the copy. Certainly this clause can only tempt honest individuals to break the law. On the other hand, modern photocopying equipment allows individuals to infringe upon the existing law every day. The textbook publishing industry has helped to create this problem by refusing to allow teachers to duplicate passages from books for testing purposes. Schools are permitted to make a duplicate video tape copy of an existing film program, but it is doubtful that they will destroy the copy once made. Accordingly, most producers and distributors charge exorbitant prices for schools for the right to copy. They feel that permitting video tape copies of films will decrease their sales to a school system because the schools will use the multiple transmission capabilities of television rather than buy enough films for the classrooms. No research has been done to prove or disprove this argument.

Another area of infringement, according to legislation now in effect, is excerpting short segments of footage from longer films. This can be resolved easily by establishing a national facility which would catalog existing film footage, source, and price. Footage cataloging is virtually nonexistent today and would require computer cataloging procedures to describe sequences.

*This section is by Joseph E. Lynch

A difficult area, avoided by the proposed copyright bill, concerns films that were produced by federal government grants. A few years ago marketing or distribution right for films, texts, and other materials were given to corporations which then priced these items at commercial rates. Competitive companies complained about the exclusive distribution rights, educators complained about the commercial prices, and the federal government was in the middle. No group of commercial companies would cooperate and market the programs on a nonexclusive basis. Also, they would not allow the program development agency to market their programs because they feared governement competition.

As curriculum development programs continue to be funded by various agencies of the federal government, some nonexclusive distribution contracts have been negotiated. However, a new problem has developed. Publishers, distributors, etc. refuse to accept a program the way it is designed, but rather wish to change content and/or form to be consistent with their own programs or manufacturing capabilities. For example, if a program consists of 10 odd sized booklets each having 10 pages, a publisher would package it in one volume of 100 standard textbook size pages. One solution to this problem is to fund the curriculum groups and allow them to develop their own distribution capability. Another alternative is to help individuals from the educational and commercial communities to establish new companies for this purpose by funding the initial capital requirements of these groups. Currently the Small Business Administration is slow to loan money for the formulation of this new type of company.

In summary, if a national program source is not available, 16mm film programs could still become less expensive if the following steps were taken:

1. Redraft the current copyright bill to better serve the needs of educators and commerical producers.
2. Create a national cataloging service so that schools can locate short film segments that best fit their needs.
3. Permit films that were produced with federal funds to be sold at less than commercial prices.
4. Permit curriculum groups to market or distribute newly developed materials.

* * *

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ABSTRACT: The COST-ED model (Costs of Schools, Training, and Education) of the instructional process encourages the recognition of alternatives and potential cost-savings. It is used to calculate the minimum cost of performing specified instructional tasks. COST-ED components are presented as cost modules in a flowchart format for manpower, teachers, facilities, attrition, and student opportunity. Computer-assisted instruction (CAI) is an educational medium which can be described within the context of the COST-ED model. CAI equipment cost factors are defined on the basis of functions performed: instructional process control, curriculum availability, or student-system communication. Radical economic difference between CAI and classroom instruction explain the "all-or-nothing-effect": CAI can be economically justified only if it becomes the dominant mode of instruction in a given instructional environment. Until CAI costs decline, applications will be confined to the military, welfare, and industrial sectors of the nation. The expansion of CAI into public education depends on methods of submitting, soliciting, and evaluating CAI projects, and on public policy measures in behalf of the educational technology industry.

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